



[7590-01-P]

NUCLEAR REGULATORY COMMISSION

[Docket No. 50-313; NRC-2015-0069]

Entergy Operations, Inc., Arkansas Nuclear One, Unit 1

AGENCY: Nuclear Regulatory Commission.

ACTION: Exemption; issuance.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is issuing an exemption in response to a March 20, 2014, request from Entergy Operations, Inc. (Entergy or the licensee), from the requirements to use Charpy V-notch (C_V) and drop weight-based methodology to determine initial nil-ductility reference temperature (RT_{NDT}) for use in evaluating the integrity of Linde 80 weld materials in the reactor pressure vessel (RPV) beltline at Arkansas Nuclear One (ANO), Unit 1. This exemption would allow the licensee to use an alternate methodology to incorporate fracture toughness test data to determine RT_{NDT} values for use in the evaluation of the RPV beltline weld material integrity in support of the development of updated pressure-temperature limit curves.

DATES: [INSERT DATE OF PUBLICATION IN THE *FEDERAL REGISTER*].

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FOR FURTHER INFORMATION CONTACT: Andrea George, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington DC 20555-0001; telephone: 301-415-1081, e-mail: Andrea.George@nrc.gov.

SUPPLEMENTARY INFORMATION:

I. Background.

Entergy is the holder of renewed Facility Operating License No. DPR-51, that authorizes operation of ANO, Unit 1. The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the NRC now or hereafter in effect.

The ANO facility consists of two pressurized-water reactors, Units 1 and 2, located in Pope County, Arkansas.

II. Request/Action.

Part 50 of title 10 of the *Code of Federal Regulation* (10 CFR), appendix G, "Fracture Toughness Requirements," specifies fracture toughness requirements for ferritic materials of pressure-retaining components of the reactor coolant pressure boundary of light water reactors to provide adequate margins of safety during any condition of normal operation, including anticipated operational occurrences and system hydrostatic tests, to which the pressure boundary may be subjected to over its service lifetime. Section 50.61, "Fracture toughness requirements for protection against pressurized thermal shock [PTS] events," provides fracture toughness requirements for protection against PTS events. A PTS event is an event or transient in pressurized water reactors (PWRs) causing severe overcooling (thermal shock) concurrent with or followed by significant pressure in the reactor vessel. Pursuant to 10 CFR 50.12, "Specific exemptions," by letter dated March 20, 2014 (ADAMS Accession No. ML14083A640), as supplemented by letter dated June 26, 2014 (ADAMS Accession No. ML14177A302), the licensee requested an exemption from certain requirements of 10 CFR

part 50, appendix G, and 10 CFR 50.61, to revise certain ANO, Unit 1 RPV initial (unirradiated) properties using AREVA Topical Report (TR) BAW-2308, Revisions 1-A and 2-A, "Initial RT_{NDT} [nil-ductility reference temperature] of Linde 80 Weld Materials."

Specifically, the licensee requested an exemption from 10 CFR part 50, appendix G.II.D(i), which requires that licensees evaluate the pre-service or unirradiated RT_{NDT} according to the procedures in the American Society of Mechanical Engineers (ASME) Code, Paragraph NB-2331, "Material for Vessels." The ASME Code Paragraph NB-2331 requires that licensees use Charpy V-notch (C_V) and drop weight-based methodology to derive the initial RT_{NDT} values. In lieu of the existing methodology described above, the licensee requested to use the alternate methodology in TR BAW-2308, Revisions 1-A and 2-A, to incorporate the use of fracture toughness test data for evaluating the integrity of the ANO, Unit 1, Linde 80 weld materials in the RPV beltline. The methodology in TR BAW-2308, Revisions 1-A and 2-A, is based on the use of the 1997 and 2002 editions of the American Society for Testing and Materials (ASTM) Standard Test Method E1921 (ASTM E1921), "Standard Test Method for Determination of Reference Temperature T_0 for Ferritic Steels in the Transition Range," and ASME Code Case N-629, "Use of Fracture Toughness Test Data to Establish Reference Temperature for Pressure Retaining Materials, Section III, Division 1, Class 1." Since the licensee is proposing an alternate method to the C_V and drop weight-based test data required by procedures in the ASME Code, Paragraph NB-2331, an exemption from portions of 10 CFR part 50, appendix G, is required.

The licensee also requested an exemption from 10 CFR 50.61(a)(5), which defines the method for evaluating initial (unirradiated) RT_{NDT} as one that uses the procedures in ASME Code, Paragraph NB-2331, which requires the use of C_V and drop weight-based test data. 10 CFR 50.61(a)(5) alternatively defines the method for evaluating RT_{NDT} as a method other than that of ASME Code, Paragraph NB-2331 approved by the Director, Office of Nuclear

Reactor Regulation (NRR). The licensee proposes to use the alternate methodology described above, in AREVA TR BAW-2308," Revisions 1-A and 2-A, to determine the initial RT_{NDT} values for the Linde 80 weld materials present in the ANO, Unit 1, RPV beltline region, which is not the procedure in ASME Code, Paragraph NB-2331 or an alternative method approved by the Director of NRR. Therefore, an exemption from 10 CFR 50.61(a)(5) is required.

III. Discussion.

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR part 50 when: (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) when special circumstances are present. Under 10 CFR 50.12(a)(2)(ii), special circumstances include, among other things, when application of the specific regulation in the particular circumstance would not serve, or is not necessary to achieve, the underlying purpose of the rule.

A. Authorized by Law.

As stated above, 10 CFR 50.12(a) allows the NRC to grant exemptions from portions of the requirements of 10 CFR part 50, appendix G and 10 CFR 50.61. Moreover, Section 50.60(b) of 10 CFR part 50 specifically allows the use of alternative methods for determining the initial material properties to 10 CFR part 50, appendix G, or portions thereof, when an exemption is granted by the Commission under 10 CFR 50.12. Because the regulations contemplate exemptions, granting the licensee's proposed exemption will not result in a violation of the Atomic Energy Act of 1954, as amended, or the NRC's regulations. Finally,

this exemption would allow the licensee to make use of fracture toughness test data for evaluating the integrity of the ANO, Unit 1 RPV Linde 80 beltline weld materials, and would not result in changes to the operation of the plant. Therefore, the exemption is authorized by law.

C. No Undue Risk to Public Health and Safety.

The underlying purpose of appendix G to 10 CFR part 50 is to set forth fracture toughness requirements for ferritic materials of pressure-retaining components of the reactor coolant pressure boundary of light-water nuclear power reactors to provide adequate margins of safety during any conditions of normal operation, including anticipated operational occurrences and system hydrostatic tests, to which the pressure boundary may be subjected over its service lifetime. The methodology underlying the requirements of appendix G to 10 CFR part 50 is based on the use of C_V and drop weight test data because of the reference to the ASME Code, Section III, Paragraph NB-2331. The licensee proposes to replace the use of existing C_V and drop weight-based methodology with an alternate methodology that uses fracture toughness test data to demonstrate compliance with appendix G to 10 CFR part 50. The alternate method, described in AREVA TR BAW-2308, Revisions 1-A and 2-A, utilizes fracture toughness data to determine the initial RT_{NDT} of the Linde 80 weld materials present in the ANO, Unit 1 RPV beltline.

The NRC staff has concluded that the requested exemption to Appendix G to 10 CFR part 50 is justified because the licensee will utilize the fracture toughness methodology specified in BAW-2308, Revisions 1-A and 2-A, within the conditions and limitations delineated in the NRC staff's safety evaluations (SEs) dated August 4, 2005, and March 24, 2008 (ADAMS Accession Nos. ML052070408 and ML080770349, respectively). The use of the methodology specified in the NRC staff's SEs will ensure that pressure-temperature limits developed for the

ANO, Unit 1 RPV will continue to be based on an adequately conservative estimate of RPV material properties and ensure that the pressure-retaining components of the reactor coolant pressure boundary retain adequate margins of safety during any condition of normal operation, including anticipated operational occurrences. This exemption only modifies the methodology to be used by the licensee under 10 CFR part 50, appendix G.II.D(i) and does not exempt the licensee from meeting any other requirement of appendix G to 10 CFR part 50.

Based on the above information, no new accident precursors are created by allowing an exemption from the use of the existing C_V and drop weight-based methodology and the use of an alternative fracture toughness-based methodology to demonstrate compliance with appendix G to 10 CFR part 50; thus, the probability of postulated accidents is not increased. Also, based on the above information, the consequences of postulated accidents are not increased. Therefore, there is no undue risk to public health and safety associated with the proposed exemption to appendix G to 10 CFR part 50.

The underlying purpose of 10 CFR 50.61 is to establish requirements for evaluating the fracture toughness of RPV materials to ensure that a licensee's RPV will be protected from failure during a PTS event. The licensee seeks an exemption from portions of 10 CFR 50.61 to use a methodology for the determination of adjusted/indexing PTS reference temperature (RT_{PTS}) values. The licensee proposes to use the methodology of TR BAW-2308, Revisions 1-A and 2-A as an alternative to the C_V and drop weight-based methodology required by 10 CFR 50.61 for determining the initial, unirradiated properties when calculating RT_{PTS} . The NRC has concluded that the exemption is justified because the licensee will utilize the methodology specified in the NRC staff's SEs regarding TR BAW-2308, Revisions 1-A and 2-A.

In TR BAW-2308, Revision 1-A, the Babcock and Wilcox Owners Group proposed to perform fracture toughness testing based on the application of the Master Curve evaluation procedure, which permits data obtained from sample sets tested at different temperatures to be

combined, as the basis for defining the initial material properties of Linde 80 welds based on T_0 (initial temperature). The NRC staff evaluated this methodology for determining Linde 80 weld initial material properties and uncertainty in those properties, as well as the overall method for combining initial material property measurements based on T_0 values (i.e. initial unirradiated nil-ductility reference temperature (IRT_{T_0}) in the BAW-2308 terminology), with property shifts from models in Regulatory Guide (RG) 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," which are based on C_V testing and defined margin term to account for uncertainties in the NRC staff's SE for TR BAW-2308, Revision 1-A. In the same NRC staff SE, Table 3, "NRC Staff-Accepted IRT_{T_0} and [Initial Margin] σ_i Values for Linde 80 Weld Wire Heats," contains the NRC staff's accepted IRT_{T_0} and initial margin (denoted as σ_i) for specific Linde 80 weld wire heat numbers.

In accordance with the limitations and conditions outlined in the NRC staff's SE for TR BAW-2308, Revision 1-A, for utilizing the values in Table 3: the licensee has (1) utilized the appropriate NRC staff-accepted IRT_{T_0} and σ_i values for applicable Linde 80 weld wire heat numbers; (2) applied a minimum chemistry factor of 167 degrees Fahrenheit ($^{\circ}\text{F}$) (values greater than 167 $^{\circ}\text{F}$ were used for certain Linde 80 weld wire heat numbers if RG 1.99, Revision 2 indicated higher chemistry factors); (3) applied a value of 28 $^{\circ}\text{F}$ for σ_{Δ} (i.e., shift margin) in the margin term; and (4) submitted values for ΔRT_{NDT} and the margin term for each Linde 80 weld in the RPV through the end of the current operating license. Additionally, the NRC's SE for TR BAW-2308, Revision 2-A concludes that the revised IRT_{T_0} and σ_i values for Linde 80 weld materials are acceptable for referencing in plant-specific licensing applications as delineated in TR BAW-2308, Revision 2-A and to the extent specified under Section 4.0, "Limitations and Conditions," of the SE. Incidentally, although Section 4.0 of the NRC staff SE states "Future plant-specific applications for RPVs containing weld heat 72105, and weld heat

299L44, of Linde 80 must use the revised IRT_{T_0} and σ_i values in TR BAW-2308, Revision 2,” the NRC notes that neither of these weld heats is used at ANO, Unit 1. Therefore, this condition does not apply to ANO, Unit 1.

During review of the licensee’s exemption request, the NRC staff noted that additional information was required in order to complete its review regarding the chemistry factors used by the licensee for calculating ΔRT_{NDT} values. The NRC staff requested this additional information via letter dated June 4, 2014 (ADAMS Accession No. ML14148A382). In the licensee’s supplement dated June 26, 2014, the licensee provided the chemistry factors in Table 1, “10 CFR 50.61 Chemistry Factors for the ANO-1 RV [Reactor Vessel] Materials.” The NRC staff confirmed that the chemistry factors used by the licensee in calculating the RT_{NDT} values were determined using the methodology of RG 1.99, Revision 2, and that 167°F is the minimum chemistry factor for Linde 80 materials.

The use of the methodology in TR BAW-2308, Revisions 1-A and 2-A, will ensure the PTS evaluation developed for the ANO, Unit 1 RPV will continue to be based on an adequately conservative estimate of RPV material properties and ensure that the RPV will be protected from failure during a PTS event. Based on the evaluations above, the NRC staff has concluded that all conditions and limitations outlined in the NRC staff’s SEs for TR BAW-2308, Revisions 1-A and 2-A, have been met for ANO Unit 1.

Based on the above information, no new accident precursors are created by allowing an exemption to the alternate methodology to comply with the requirements of 10 CFR 50.61 in determining adjusted/indexing reference temperatures; thus, the probability of postulated accidents is not increased. Also, based on the above information, the consequences of postulated accidents are not increased. Therefore there is no undue risk to public health and safety.

D. Consistent with the Common Defense and Security.

The licensee requested an exemption in order to utilize an alternative methodology from that specified in portions of 10 CFR part 50, appendix G, and 10 CFR 50.61, to allow the use of fracture toughness test data for evaluating the integrity of the ANO, Unit 1 RPV beltline Linde 80 weld materials. This exemption request is not related to, and does not impact, any security issues at ANO, Unit 1. Therefore, the NRC has determined that this exemption does not impact, and is consistent with, the common defense and security.

E. Special Circumstances.

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule. The underlying purpose of 10 CFR 50.61(a)(5) and 10 CFR part 50, appendix G.II.D(i) is to set forth fracture toughness requirements (e.g., initial RT_{NDT} values) for ferritic materials of pressure-retaining components of the reactor coolant pressure boundary of light water nuclear power reactors, in order to provide adequate margins of safety during any conditions of normal operation, including anticipated operational occurrences and system hydrostatic tests, to which the pressure boundary may be subjected over its service lifetime. The underlying purpose of 10 CFR 50.61 is to establish requirements for evaluating the fracture toughness of RPV materials to ensure that a licensee's RPV will be protected from failure during a PTS event.

Entergy's exemption request proposes an alternate methodology to evaluate the RT_{NDT} of Linde 80 weld materials in the RPV beltline region at ANO, Unit 1, based on fracture

toughness test data found in AREVA TR BAW-2308, Revision 1-A and 2-A (in accordance with ASTM Standard E1921 and ASME Code Case N-629). This proposed alternate methodology achieves the underlying purpose of 10 CFR part 50 appendix G.II.D(i) because it provides an adequate conservative estimate of RPV materials properties and ensures that the pressure-retaining components of the RPV retain adequate margins for safety during any condition of normal operation. The alternate methodology also achieves the underlying purpose of 10 CFR 50.61(a)(5) because it will ensure that the PTS evaluation developed for the ANO, Unit 1 RPV will continue to be based on an adequately conservative estimate of RPV material properties and ensure that the RPV will be protected from failure during a PTS event. Accordingly, the NRC has concluded that using the procedures in the ASME Code, Paragraph NB-2331 is not necessary to achieve the underlying purpose of 10 CFR 50.61(a)(5) and 10 CFR part 50 appendix G.II.D(i). Therefore, the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption exist.

F. Environmental Considerations.

The NRC staff determined that the exemption discussed herein meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9) because it is related to a requirement concerning the installation or use of a facility component located within the restricted area, as defined in 10 CFR part 20, and issuance of this exemption involves: (i) No significant hazards consideration, (ii) no significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, and (iii) no significant increase in individual or cumulative occupational radiation exposure. Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's consideration of this exemption request. The basis for the NRC

staff's determination is discussed as follows with an evaluation against each of the requirements in 10 CFR 51.22(c)(9)(i)-(iii).

Requirements in 10 CFR 51.22(c)(9)(i)

The NRC evaluated whether the exemption involves no significant hazards consideration using the standards described in 10 CFR 50.92(c), as presented below:

1. Does the proposed exemption involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The exemption would allow the use of alternate methodologies from those specified in appendix G to 10 CFR part 50, and 10 CFR 50.61, to allow the use of fracture toughness test data for evaluating the integrity of RPV beltline welds. Use of the alternate methodology for determining the initial, unirradiated material reference temperatures of the Linde 80 weld materials present in the RPV beltline region will not result in changes in operation of configuration of the facility. The change in reactor vessel material initial properties will continue to satisfy the intent of 10 CFR 50, Appendix G, and 10 CFR 50.61. The change does not adversely affect accident initiators or pre-cursors, nor alter the design assumptions, conditions, or the manner in which the plant is operated and maintained. The change does not alter or prevent the ability of structures, systems or components from performing their intended function to mitigate the consequences of an initiating event with the assumed acceptance limits. There will be no adverse change to normal plant operating parameters, engineered safety feature actuation setpoints, accident mitigation capabilities, or accident analysis assumptions or inputs. The change does not affect the source term, containment isolation, or radiological release assumptions used in evaluating the radiological consequences of an accident previously evaluated. Further, the change does not increase the types of amounts of radioactive effluent

that may be released offsite, nor significantly increase individual or cumulative occupational/public radiation exposures.

Therefore, the proposed exemption does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed exemption create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The exemption would allow the use of alternate methodologies from those specified in appendix G to 10 CFR part 50, and 10 CFR 50.61, to allow the use of fracture toughness test data for evaluating the integrity of RPV beltline welds. Use of the alternate methodology for determining the initial, unirradiated material reference temperatures of the Linde 80 weld materials present in the RPV beltline region will not result in changes in operation or configuration of the facility. The change does not impose any new or different requirements or eliminate any existing requirements. The change is consistent with the current safety analysis assumptions and current plant operating practice. No new accident scenarios, transient precursors, failure mechanisms, or limiting single failures are introduced as a result of the proposed change. Equipment important to safety will continue to operate as designed. The change does not result in any event previously deemed incredible being more credible. The change does not result in any adverse conditions or result in any increase in the challenges to safety systems.

Therefore, this change does not create the possibility of a new or different kind of accident from an accident previously evaluated.

3. Does the proposed exemption involve a significant reduction in a margin of safety?

Response: No.

The proposed exemption does not alter safety limits, limiting safety system settings, or limiting conditions for operation. The setpoints at which protective actions are initiated are not altered by the change. There are no new or significant changes to initial conditions contributing to accident severity or consequences. The exemption will not otherwise affect plant protective boundaries, will not cause a release of fission products to the public, nor will it degrade the performance of any other structures, systems or components important to safety.

Therefore, the proposed exemption does not involve a significant reduction in a margin of safety.

Based on the above evaluation of the standards set forth in 10 CFR 50.92(c), the NRC concludes that the proposed exemption involves no significant hazards consideration. Accordingly, the requirements of 10 CFR 51.22(c)(9)(i) are met.

Requirements in 10 CFR 51.22(c)(9)(ii-iii)

The proposed exemption does not make any changes to the facility, equipment at the facility, or to fuel or core design. The proposed alternate methodology serves the same purpose as the requirements set forth in 10 CFR 50.61 and 10 CFR part 50, appendix G. Therefore, the NRC concludes that the exemption involves no significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative public or occupational radiation exposure.

Therefore, the requirements of 10 CFR 51.22(c)(9)(ii-iii) are met.

Conclusion

Based on the above, the NRC concludes that the proposed exemption meets the

eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's issuance of this exemption.

IV. Conclusions.

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present. Therefore, the Commission hereby grants the licensee an exemption from 10 CFR part 50, appendix G.II.D(i) and 10 CFR 50.61(a)(5) requirements, in order to use the alternate methodology specified in AREVA TR BAW-2308, Revisions 1-A and 2-A, in lieu of the existing requirement to use C_V and drop weight-based methodologies to evaluate the initial (unirradiated) RT_{NDT} of the Linde 80 weld materials in the RPV beltline region at ANO, Unit 1.

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 16th day of March 2015.

For the Nuclear Regulatory Commission.

Michele G. Evans, Director,
Division of Operating Reactor Licensing,
Office of Nuclear Reactor Regulation.

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